attract flies, which are often imprisoned by the rapid closing of the glumes. These flies seem often affected by the entomophthora disease, and it is suggested that when so suffering they are often compelled by thirst to seek the juice of the lodicules. In other cases, no doubt, they visit the flowers for the purpose of collecting pollen.

A very valuable appendix, occupying about 100 pages, is added to the volume, and gives a systematic list of the various insects which have been observed visiting flowers and the flowers which they usually frequent. This carefully compiled list will be as informing to the entomologist as to the botanist. The index of plants described in the volume which figures in the German edition has not been added in the translation, but is probably held over for the final volume.

The style of the English rendering is fluent, and generally free from the flaws that mark some translations, though the volume opens with a serious blunder in describing the flowers of Lobelia as actinomorphous. Hälftig-symmetrisch is, of course, bilaterally symmetrical or zygomorphic, as is, indeed, indicated by the concluding portion of the sentence which describes the bifid upper and the trifid lower lip. It is unfortunate that the translator has retained the use of the word œcology as a synonym for biology, in dealing with observations on flower pollination. Though formerly used in that sense, œcology has of late years been so definitely and much more correctly applied to the study of plant-life in relation to environment that it seems out of place when used for floral biology.

Apart from such minor defects, the translation will be welcomed as rendering Knuth's monumental work accessible to a wider circle of readers and students of plant biology.

PRACTICAL WORK FOR ELECTRICAL LABORATORIES.

Leitfaden zum elektrotechnischen Praktikum. By Dr. G. Brion. Pp. xiv+404. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE laboratory has always been regarded as a necessary complement to the class-room so far as physics and chemistry are concerned, but for engineering subjects it is a comparatively modern institution. There are still engineers amongst us who have had to go through their university training without enjoying the use of a laboratory, but within the last generation all technical universities and colleges have recognised the immense importance of laboratory work, and have fitted up hydraulic, heat, mechanical, and electrical laboratories on a more or less extensive scale. Teachers, as well as engineers in practice, are agreed on the necessity of supplementing the theoretical work of the class-room by experiment, and there is keen competition between the different institutions as regards the best equipment, each trying to profit by the experience of the others, and to adapt the plant to the special industrial requirements of its district.

The best equipped laboratory would, however, be of little value without good organisation in its use and scientific instruction in the way of carrying out experiments. The book under review is an attempt, and, let us hasten to say, a very successful attempt, to supply such instruction. Of all Continental technical high schools, Dresden has at the present moment the best equipped electrical engineering laboratory, and since its head, Prof. Goerges, is not only an accomplished teacher, but also an engineer of high reputation, we may expect that a book, treating of laboratory work as carried on under him, will prove a most useful publication. The author is lecturer at Dresden, and in the preface says that the methods described have been worked out from time to time by various members of the staff. This does not mean that the methods described, or even a majority of them, are new, but simply that all the methods described have actually been used in that laboratory, and that in this way the educational value of each has been put to the test.

If an author describes the equipment of and work done in the laboratory in which he works himself, there is danger that he will produce a somewhat one-sided account, but from such a reproach Mr. Brion is entirely free. All the author has to say on testing applies to any well-equipped laboratory, and there is a remarkable absence of references to special apparatus. He evidently does not hold with the custom of giving the student cut-and-dried instructions, such as "take Messrs. So and So's testing set, connect in such a manner, then turn the handle and read off the result." Wherever possible he not only lets the student build up his apparatus, but he gives him also a short theory of the test. The object of the student's work in the laboratory is primarily to verify by experiment certain physical relations of which he has heard the theory in the class-room. Since, however, the simple and fundamental physical relations are in practical machinery often overshadowed by secondary disturbing causes, it is important that these should be pointed out to the student, and that he should thus be trained to scrutinise his results so as to separate that which is important from that which is merely accidental or disturbing. In this direction, Mr. Brion has given us good advice in sufficient detail. To give such advice it is, however, necessary to introduce a certain amount of theoretical matter on a mathematical basis.

A casual glance through the pages of this book gives one more the impression of a text-book than of a laboratory manual, but on closer inspection one finds that only as much theory is introduced as is necessary for intelligent working. Among the good features of the book are the diagrammatic representations of circuits, machines, and apparatus. With a correct appreciation of the probability that the students who work now in the laboratory will in a year or two be working in practice, Mr. Brion has adopted in his diagrams the symbolic representation recommended by the Verband Deutscher Elektrotechniker. He also uses thick lines to represent wires which carry main currents and thin lines for wires carrying shunt currents or for voltmeter wires. This is apparently a small matter, but anyone who has to trace out the circuits in some complicated electrical

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connection will appreciate the advantage of making the distinction. It is, however, to be regretted that in the matter of notation the author is too intensely German. He puts P for force, A for energy, L for power, D for torque, and so on, all letters which have internationally already a significance. The reader is thus put unnecessarily to the trouble and mental strain to substitute for symbols he is accustomed to use (and which, to a certain degree, have already received the sanction of the International Electrotechnical Commission) others which are unfamiliar to him.

It is not necessary to enumerate the contents of this book in detail; suffice it to say that it broadly covers the subject of laboratory tests such as are necessary for students. As to the question of which tests are necessary and which may be omitted, opinions will always differ. It would be easy to give a list of tests which, in the reviewer's opinion, ought to have been included, but such criticism would hardly be fair, for a book on testing cannot contain every possible test, but only a selection of those which the author himself has found suitable. On the whole, the author has given us a very representative and useful selection, covering a wide field. His book will be found to be a most helpful guide to electrical laboratory work generally. GISBERT KAPP.

ANCIENT HINDU CHEMISTRY.

A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, &c. By Prof. Praphulla Chandra Ray. Vol. ii. Pp. xcvi+293+152+xxi. (Calcutta: The Bengal Chemical and Pharmaceutical Works, Ltd.; London: Williams and Norgate, 1909.) Price 10*s.* 6*d.* net.

IN the first volume of this book, which was published in 1902, and reviewed in these columns on May 21, 1903, Prof. Ray dealt with all the oldest (pre-Buddha) Hindu MSS., and many of the later ones. A number of MSS. remained untouched, and now that these have been examined, the concluding volume has been issued. It has been a labour of love which has occupied all Prof. Ray's spare time for the last fifteen years, and the great value of the results of his patient and laborious researches will be fully appreciated by all students of the history of chemistry.

The difficulties of determining the extent of Indian chemical lore in ancient times are profound. There is no doubt that at a very early period the Arians attained great proficiency in the manufacturing industries, which must have rested on a good practical knowledge of chemical reactions. The famous sword-blades, called by the Greeks "marvellous swords," and by the Western world "Damascened blades," were brought to Europe by way of Damascus, but were made in India. The making and polishing of glass in India, including lenses and mirrors of various kinds, spherical, oval, &c., was a well-known industry. Pliny mentions that the best glass ever made was Indian glass. In pharmacy, in dyeing, in the manufacture of perfumery and cosmetics, complicated chemical operations must have been carried out even before the time of Buddha, which is placed about B.C. 500.

There is, however, little or no trace of these things in the literature of the period. The caste system was radically opposed to the formation of a science in which practice is based on theory. The chemical industries were exercised by a despised caste, that of the *cudras*, and their labours were no doubt deemed unworthy of being described by the caste of the *Brahmins*, or priests, who alone understood the art of writing. Thus Hoefer, for example, remarks that amongst the Sanskrit manuscripts in the Bibliothèque Imperiale, of Paris, no document occurs which can be of interest to the historian of chemistry, and Berthelot in his "Origines de l'Alchemie" practically ignores India.

The MSS. patiently examined by Prof. Ray appear to consist largely of religious or philosophical reflections, with occasional somewhat obscure references to chemical subjects made for the purpose of illustration. Thus in a document called "Rasaratnakara," written by Nagarjuna, who was the High Priest of Buddha about A.D. 150, such texts as the following occur:—

> "What wonder is it that cinnabar digested several times with the milk of the ewe and the [vegetable] acids imparts to silver the lustre of gold glowing as saffron?"

And a little further on:—

> "Silver alloyed with lead and fused with ashes becomes purified,"

which is a clear allusion to cupellation.

It is probable that the pundits, when referring to metal-working, often knew very little of the subjects they mentioned, but Nagarjuna was celebrated as an alchemist. Prof. Ray argues at some length in favour of the indigenous origin of Indian alchemy, and, however degrading it may have been to work, it does not appear to have been derogatory to the dignity of the sages to discuss the manufacture of gold or silver. Thus—

> "Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth."

The last 150 pages of the book consist of a reproduction of original Sanskrit texts, taken from many different MSS. T. K. R.

AN ENCYCLOPÆDIA OF THE SCIENCES.

Instruments optiques d'Observation et de Mesure. By Jules Raibaud. Pp. 380. (Paris: O. Doin et Fils, 1909.) Price 5 francs.

THIS volume is a unit in a somewhat extensive undertaking, no less than an encyclopædia of all the sciences, pure and applied, physical and biological, material, mental, and moral. The scheme is of a somewhat novel character; its magnitude may be judged from the fact that it involves a total of some thousand volumes, arranged in forty sections or "bibliothèques," the whole to rival, we are told, the largest encyclopædias of this or any other country—and not only in size. The novelty lies mainly in the fact that each volume is to be independent, and have its own individuality; each will be a monograph dealing with a special branch of the particular section to which it belongs. The size and price will be uniform, the number of pages approximately so. One

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